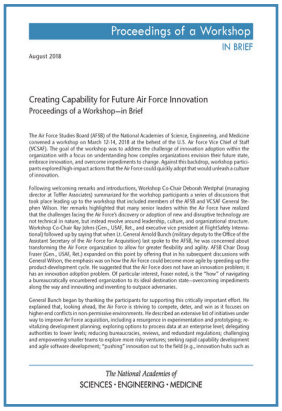
ADAPTING TO THE 21ST CENTURY INNOVATION ENVIRONMENT

October 16-17, 2018 | National Academy of Sciences Building | Washington, DC 20418

List of selected reports from the National Academies Press related to the meeting topic.

OPEN SCIENCE BY DESIGN: REALIZING A VISION FOR THE 21ST CENTURY (2018)
Openness and sharing of information are fundamental to the progress of science and to the effective functioning of the research enterprise. The advent of scientific journals in the 17th century helped power the Scientific Revolution by allowing researchers to communicate across time and space, using the technologies of that era to generate reliable knowledge more quickly and efficiently. Harnessing today's stunning, ongoing advances in information technologies, the global research enterprise and its stakeholders are moving toward a new open science ecosystem. Open science aims to ensure the free availability and usability of scholarly publications, the data that result from scholarly research, and the methodologies, including code or algorithms, that were used to generate those data. Open Science by Design is aimed at overcoming barriers and moving toward open science as the default approach across the research enterprise. This report explores specific examples of open science and discusses a range of challenges, focusing on stakeholder perspectives. It is meant to provide guidance to the research enterprise and its stakeholders as they build strategies for achieving open science and take the next steps.



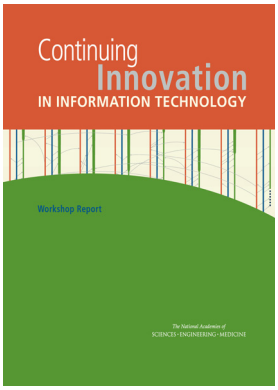
CREATING CAPABILITY FOR FUTURE AIR FORCE INNOVATION: PROCEEDINGS OF A WORKSHOP–IN BRIEF (2018)
The National Academies of Science, Engineering, and Medicine convened a workshop on March 12-14, 2018 at the behest of the U.S. Air Force Vice Chief of Staff. The goal of the workshop was to address the challenge of innovation adoption within the organization with a focus on understanding how complex organizations envision their future state, embrace innovation, and overcome impediments to change. Against this backdrop, workshop participants explored high-impact actions that the Air Force could quickly adopt that would unleash a culture of innovation. This publication briefly summarizes the presentations and discussions from the workshop.

INTERNATIONAL COORDINATION FOR SCIENCE DATA INFRASTRUCTURE: PROCEEDINGS OF A WORKSHOP—IN BRIEF (2018)
Advances in science and technology have led to the creation of large amounts of data—data that could be harnessed to improve productivity, cure disease, and address many other critical issues. Consensus in the scientific community is growing that the transition to truly data-driven and open science is best achieved by the establishment of a globally interoperable research infrastructure. A number of projects are looking to establish this infrastructure and exploit data to its fullest potential. Several projects in the United States, Europe, and China have made significant strides toward this effort. The goal of these projects is to make research data findable, accessible, interoperable, and reusable, or FAIR. The expected impact and benefits of FAIR data are substantial. To realize these benefits, there is a need to examine critical success factors for implementation, including training of a new generation of data experts to provide the necessary capacity. On November 1, 2017, the National Academies of Sciences, Engineering, and Medicine organized a symposium to explore these issues. This publication briefly summarizes the presentations and discussions from the symposium.

The National Academies of | SCIENCES ENGINEERING MEDICINE

A NEW VISION FOR CENTER-BASED ENGINEERING RESEARCH (2017)
The future security, economic growth, and competitiveness of the United States depend on its capacity to innovate. Major sources of innovative capacity are the new knowledge and trained students generated by U.S. research universities. However, many of the complex technical and societal problems the United States faces cannot be addressed by the traditional model of individual university research groups headed by a single principal investigator. Instead, they can only be solved if researchers from multiple institutions and with diverse expertise combine their efforts. The National Science Foundation (NSF), among other federal agencies, began to explore the potential of such center-scale research programs in the 1970s and 1980s; in many ways, the NSF Engineering Research Center (ERC) program is its flagship program in this regard. The ERCs are "interdisciplinary, multi-institutional centers that join academia, industry, and government in partnership to produce transformational engineered systems and engineering graduates who are adept at innovation and primed for leadership in the global economy. To ensure that the ERCs continue to be a source of innovation, economic development, and educational excellence, A New Vision for Center-Based Engineering Research explores the future of center-based engineering research, the skills needed for effective center leadership, and opportunities to enhance engineering education through the centers.

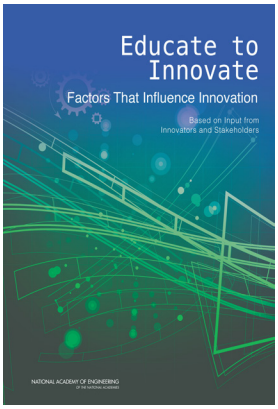
ADVANCING CONCEPTS AND MODELS FOR MEASURING INNOVATION PROCEEDINGS OF A WORKSHOP (2017)
Because of the role of innovation as a driver of economic productivity and growth and as a mechanism for improving people's well-being in other ways, understanding the nature,determinants, and impacts of innovation has become increasingly important to policy makers. To be effective, investment in innovation requires this understanding, which, in turn, requires measurement of the underlying inputs and subsequent outcomes of innovation processes. In May 2016, at the request of the National Center for Science and Engineering Statistics of the National Science Foundation, the Committee on National Statistics of the National Academies of Sciences, Engineering, and Medicine convened a workshop - bringing together academic researchers, private and public sector experts, and representatives from public policy agencies - to develop strategies for broadening and modernizing innovation information systems.This publication summarizes the presentation and discussion of the event.



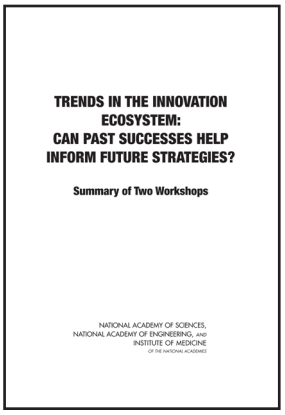
CONTINUING INNOVATION IN INFORMATION TECHNOLOGY (2016)
The 2012 National Research Council report Continuing Innovation in Information Technology illustrates how fundamental research in information technology (IT), conducted at industry and universities, has led to the introduction of entirely new product categories that ultimately became billion-dollar industries. The central graphic from that report portrays and connects areas of major investment in basic research, university-based research, and industry research and development; the introduction of important commercial products resulting from this research; billion-dollar-plus industries stemming from it; and present-day IT market segments and representative U.S. firms whose creation was stimulated by the decades-long research. At a workshop hosted by the Computer Science and Telecommunications Board on March 5, 2015, leading academic and industry researchers and industrial technologists described key research and development results and their contributions and connections to new IT products and industries, and illustrated these developments as overlays to the 2012 "tire tracks" graphic. The principal goal of the workshop was to collect and make available to policy makers and members of the IT community first-person narratives that illustrate the link between government investments in academic and industry research to the ultimate creation of new IT industries. This report provides summaries of the workshop presentations organized into five broad themes - (1) fueling the innovation pipeline, (2) building a connected world, (3) advancing the hardware foundation, (4) developing smart machines, and (5) people and computers - and ends with a summary of remarks from the concluding panel discussion.

A VISION FOR THE FUTURE OF CENTER-BASED MULTIDISCIPLINARY ENGINEERING RESEARCH: PROCEEDINGS OF A SYMPOSIUM (2016)
Out of concern for the state of engineering in the United States, the National Science Foundation (NSF) created the Engineering Research Centers (ERCs) with the goal of improving engineering research and education and helping to keep the United States competitive in global markets. Since the ERC program's inception in 1985, NSF has funded 67 ERCs across the United States. NSF funds each ERC for up to 10 years, during which time the centers build robust partnerships with industry, universities, and other government entities that can ideally sustain them upon graduation from NSF support. To ensure that the ERCs continue to be a source of innovation, economic development, and educational excellence, NSF commissioned the National Academies of Sciences, Engineering, and Medicine to convene a 1-day symposium in April 2016. This event featured four plenary panel presentations on: the evolving global context for center-based engineering research, trends in undergraduate and graduate engineering education, new directions in university-industry interaction, and emerging best practices in translating university research into innovation. This publication summarizes the presentations and discussions from the symposium.

EDUCATE TO INNOVATE: FACTORS THAT INFLUENCE INNOVATION (2016)
Robust innovation in the United States is key to a strong and competitive industry and workforce. Efforts to improve the capacity of individuals and organizations to innovate must be a high national priority to ensure that the United States remains a leader in the global economy. How is the United States preparing its students and workers to innovate and excel? What skills and attributes need to be nurtured? The aim of the Educate to Innovate project is to expand and improve the innovative capacity of individuals and organizations by identifying critical skills, attributes, and best practices - indeed, cultures - for nurturing them. The project findings will enable educators in industry and at all levels of academia to cultivate the next generation of American innovators and thus ensure that the U.S. workforce remains highly Competitive in the face of rapid technological changes. Educate to Innovate summarizes the keynote and plenary presentations from a workshop convened in October 2013. The workshop brought together innovators and leaders from various fields to share insights on innovation and its education. This report continues on to describe the specific skills, experiences, and environments that contribute to the success of innovators, and suggests next steps based on discussion from the workshop.

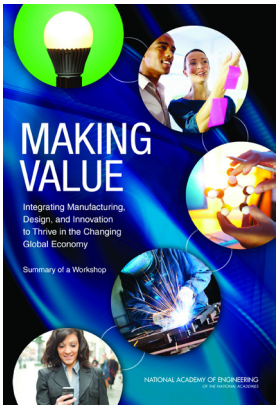


FURTHERING AMERICA'S RESEARCH ENTERPRISE (2014)
Scientific research has enabled America to remain at the forefront of global competition for commercially viable technologies and other innovations. For more than 65 years, the United States has led the world in science and technology. Discoveries from scientific research have extended our understanding of the physical and natural world, the cosmos, society, and of humans - their minds, bodies, and economic and other social interactions. Through these discoveries, science has enabled longer and healthier lives, provided for a better-educated citizenry, enhanced the national economy, and strengthened America's position in the global economy. At a time of budget stringency, how can we foster scientific innovation to ensure America's unprecedented prosperity, security, and quality of life? Although many studies have investigated the impacts of research on society, Furthering America's Research Enterprise brings to bear a fresh approach informed by a more holistic understanding of the research enterprise as a complex, dynamic system. This understanding illuminates why America's research enterprise has historically been so successful; where attention should be focused to increase the societal benefits of research investments; and how those who make decisions on the allocation of funds for scientific research can best carry out their task. This report will be of special interest to policy makers who support or manage the research enterprise, to others in public and private institutions who fund research, to scholars of the research enterprise, and to scientists and engineers who seek to better understand the many pathways through which their research benefits society.



TRENDS IN THE INNOVATION ECOSYSTEM: CAN PAST SUCCESSES HELP INFORM FUTURE STRATEGIES? SUMMARY OF TWO WORKSHOPS (2013)
Innovation has been a major engine of American economic and societal progress. It has increased per capita income more than sevenfold since the 19th century, has added three decades to the average lifespan, has revolutionized the way we communicate and share information, and has made the United States the strongest military power in the world. Without its historical leadership in innovation, the United States would be a very different country than it is today. Trends in the Innovation Ecosystem is the summary of two workshops hosted by the Committee on Science, Engineering, and Public Policy (COSEPUP) of the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine in February and May, 2013. Experts from industry, academia, and finance met to discuss the challenges involved in innovation pathways. Both workshops focused on the interactions between research universities and industry and the concept of innovation as a "culture" as opposed to an operational method. The goal was to gain a better understanding of what key factors contributed to successful innovations in the past, how today's environment might necessitate changes in strategy, and what changes are likely to occur in the future in the context of a global innovation ecosystem. This report discusses the state of innovation in America, obstacles to both innovation and to reaping the benefits of innovation, and ways of overcoming those obstacles.

RISING TO THE CHALLENGE: U.S. INNOVATION POLICY FOR THE GLOBAL ECONOMY (2012)
America's position as the source of much of the world's global innovation has been the foundation of its economic vitality and military power in the post-war. No longer is U.S. pre-eminence assured as a place to turn laboratory discoveries into new commercial products, companies, industries, and high-paying jobs. As the pillars of the U.S. innovation system erode through wavering financial and policy support, the rest of the world is racing to improve its capacity to generate new technologies and products, attract and grow existing industries, and build positions in the high technology industries of tomorrow. *Rising to the Challenge: U.S. Innovation Policy for Global Economy* emphasizes the importance of sustaining global leadership in the commercialization of innovation which is vital to America's security, its role as a world power, and the welfare of its people. The second decade of the 21st century is witnessing the rise of a global competition that is based on innovative advantage. To this end, both advanced as well as emerging nations are developing and pursuing policies and programs that are in many cases less constrained by ideological limitations on the role of government and the concept of free market economics. The rapid transformation of the global innovation landscape presents tremendous challenges as well as important opportunities for the United States. This report argues that far more vigorous attention be paid to capturing the outputs of innovation - the commercial products, the industries, and particularly high-quality jobs to restore full employment. America's economic and national security future depends on our succeeding in this endeavor.

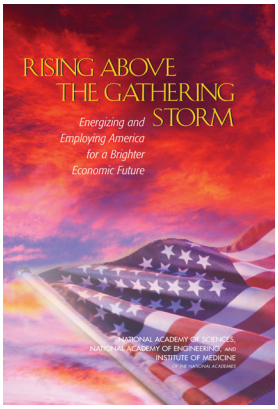


MAKING VALUE: INTEGRATING MANUFACTURING, DESIGN, AND INNOVATION TO THRIVE IN THE CHANGING GLOBAL ECONOMY. SUMMARY OF A WORKSHOP (2012)
Manufacturing is in a period of dramatic transformation. But in the United States, public and political dialogue is simplistically focused almost entirely on the movement of certain manufacturing jobs overseas to low-wage countries. The true picture is much more complicated, and also more positive, than this dialogue implies. The National Academy of Engineering has been concerned about the issues surrounding manufacturing and is excited by the prospect of dramatic change. On June 11-12, 2012, it hosted a workshop in Washington, DC, to discuss the new world of manufacturing and how to position the United States to thrive in this world. The workshop steering committee focused on two particular goals. First, presenters and participants were to examine not just manufacturing but the broad array of activities that are inherently associated with manufacturing, including innovation and design. Second, the committee wanted to focus not just on making things but on making value, since value is the quality that will underlie high-paying jobs in America's future. Making Value: Integrating Manufacturing, Design, and Innovation to Thrive in the Changing Global Economy summarizes the workshop and the topics discussed by participants.

MEASURING THE IMPACTS OF FEDERAL INVESTMENTS IN RESEARCH: A WORKSHOP SUMMARY (2011)

The enactment of the America COMPETES Act in 2006 (and its reauthorization in 2010), the increase in research expenditures under the 2009 American Recovery and Reinvestment Act (ARRA), and President Obama's general emphasis on the contribution of science and technology to economic growth have all heightened interest in the role of scientific and engineering research in creating jobs, generating innovative technologies, spawning new industries, improving health, and producing other economic and societal benefits. Along with this interest has come a renewed emphasis on a question that has been asked for decades: Can the impacts and practical benefits of research to society be measured either quantitatively or qualitatively? On April 18-19, 2011, the Board on Science, Technology, and Economic Policy (STEP) and the Committee on Science, Engineering and Public Policy (COSEPUP), held a workshop to examine this question. The workshop sought to assemble the range of work that has been done in measuring research outcomes and to provide a forum to discuss its method. The workshop was motivated by a 2009 letter from Congressman Rush Holt (D-New Jersey). He asked the National Academies to look into a variety of complex and interconnected issues, such as the short-term and long-term economic and non-economic impact of federal research funding, factors that determine whether federally funded research discoveries result in economic benefits, and quantification of the impacts of research on national security, the environment, health, education, public welfare, and decision making.

RISING ABOVE THE GATHERING STORM ENERGIZING AND EMPLOYING AMERICA FOR A BRIGHTER ECONOMIC FUTURE (2007)



This report recommends improvements in K-12 science and mathematics education, increasing and enhancing the nation's investment in basic research, attracting the best and brightest to pursue science and engineering degrees, and changes in the innovation environment so that the US is the most attractive country in the world to invest. All 20 actions recommended in the report were incorporated into proposed policy actions, and three became part of President Bush's American Competitiveness Initiative, announced in his 2006 State of the Union message. The 20 actions were included in a set of three Senate bills called Protecting America's Competitive Edge (PACE) as well as several bills from the House Science Committee. Provisions were also added to existing bills, such as the provision in the Senate immigration bill to grant permanent residency to foreign students graduating with advanced degrees in science and engineering from U.S. universities. their collection, processing, utility, and validation; and approaches that can be learned from other sectors to inform big data strategies for infectious disease research, operations, and policy.

About the Government-University-Industry Research Roundtable (GUIRR)

GUIRR's mission is to convene senior-most representatives from government, universities, and industry to define and explore critical issues related to the national and global science and technology agenda that are of shared interest; to frame the next critical question stemming from current debate and analysis; and to incubate activities of on-going value to the stakeholders. The forum is designed to facilitate candid dialogue among participants, to foster self-implementing activities, and, where appropriate, to carry awareness of consequences to the wider public.

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For more information about GUIRR, visit our web site at www.nas.edu/guirr
500 Fifth Street, N.W. Washington, D.C. 20001 • guirr@nas.edu